

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

DIM5058 – MATHEMATICAL TECHNIQUES 1

(For DIT students only)

27 OCTOBER 2017
09.00 am - 11.00 am
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 3 pages with 4 questions. Key formulae are given in the Appendix.
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.
4. All necessary working steps must be shown.

Question 1

- a) Rationalize the denominator of $\frac{\sqrt{5}+5}{1-\sqrt{5}}$ and simplify your answer. (4 marks)
- b) Solve the equation $3xy^2 - 75x - 2y^2 = -50$. (5 marks)
- c) Solve the equation $5x^2 + 2x - 7 = 0$ by using **completing the square method**. (6 marks)
- d) Solve the absolute inequality $|8x - 5| + 2x - 1 < 10 + 2x$ and represent the answer on an interval notation. (5 marks)

[TOTAL 20 MARKS]**Question 2**

- a) Given that $g(x) = \frac{3x-5}{4}$ and $h(x) = \frac{4+3x}{9}$.
- i) Find $(g+h)(x)$. (4 marks)
 - ii) Evaluate $g^{-1}(1)$. (3 marks)
- b) Given a quadratic function $f(x) = (x+2)(1-x)$.
- i) Determine whether the parabola opens upward or downward. (2 marks)
 - ii) Find the vertex of the parabola. (3 marks)
 - iii) Find the x -intercept(s). (3 marks)
 - iv) Find the y -intercept. (1 marks)
 - v) Sketch the parabola and label the necessary points. (4 marks)

[TOTAL 20 MARKS]**Continued...**

Question 3

a) Given that $A = \begin{bmatrix} 3 & -7 & 4 \\ 4 & 5 & 8 \\ 8 & -6 & 10 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 10 & -7 \\ 3 & 1 & -9 \\ -2 & 11 & 1 \end{bmatrix}$.

i) Find $3A + 4B$. (4 marks)

ii) Find $B^T - A$. (3 marks)

b) Given that $A = \begin{bmatrix} 5 & 4 \\ 4 & 3 \end{bmatrix}$ and $M = \begin{bmatrix} -14 & 20 \\ -12 & 17 \end{bmatrix}$.

i) If $AA^{-1} = A^{-1}A = I$, find A^{-1} . (3 marks)

ii) From part (i), show that $A^{-1}M^T = \begin{bmatrix} 122 & 104 \\ -156 & -133 \end{bmatrix}$. (5 marks)

- c) A furniture company produces three types of desks: a traditional model, modern model and deluxe model. Each desk is manufactured in three stages: cutting, construction and finishing. The time requirements for each model and manufacturing stage are given in the following table.

Manufactured Process	Model		
	Traditional	Modern	Deluxe
Cutting	2	3	2
Construction	2	1	3
Finishing	1	1	2

Each week the company has available a maximum of 100 hours for cutting, 100 hours for construction and 65 hours for finishing. [Hint: Let x , y and z be the number of desks for traditional, modern and deluxe model respectively.]

i) Represent the above information in the form of $AX = B$. (2 marks)

ii) From part (i), solve the value of x , y and z by using **Cramer's Rule**. (13 marks)

[TOTAL 30 MARKS]

Continued...

Question 4

- a) Write the first five terms of the sequence whose general form is $a_n = \frac{3a_{n-1} + 1}{(n+1)!}$ and given the first term is $a_1 = -5$. (4 marks)
- b) Find the sum for $\sum_{x=1}^6 \frac{(2x+5)^2}{2^x}$. (4 marks)
- c) Insert three arithmetic mean between number 13 and 161. (3 marks)
- d) At the corner section of a football stadium, there are 8 seats in the first row and 35 rows in total. Each successive row contains 4 additional seats.
- Find the first term and the common difference. (2 marks)
 - Calculate the number of seats in the last row. (2 marks)
 - Find the total number of seats in the corner section. (2 marks)
- e) Sarah has been hired by PQR company with an annual salary of RM28,000 and is expected to receive an annual increase of 6%. What will Sarah's annual salary be in her ninth year of service? (3 marks)
- f) The sum to infinity of a geometric series is 280. If the first term is 182, find the common ratio. (4 marks)
- g) Find the 4th and 9th term for the binomial expansion $(2x^3 + y^2)^{10}$. (6 marks)

[TOTAL 30 MARKS]**End of Page.**

APPENDIX – KEY FORMULA

Inequalities:

<i>Inequality</i>	<i>Solution</i>
$ x < a$	$-a < x < a$
$ x \leq a$	$-a \leq x \leq a$
$ x > a$	$x < -a \quad \text{or} \quad x > a$
$ x \geq a$	$x \leq -a \quad \text{or} \quad x \geq a$

Completing the square: $x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2$

Quadratic formula: If $ax^2 + bx + c = 0$ where $a \neq 0$, then, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Standard form of a quadratic function: $f(x) = a(x - h)^2 + k$, $a \neq 0$

<i>Determinant of a 2×2 matrix</i>	<i>Determinant of a 3×3 matrix</i>
$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1 b_2 - a_2 b_1$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} \\ = a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1 \begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1 \begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$
<i>Inverse of a 2×2 matrix</i>	<i>Inverse of a 3×3 matrix</i>
<p>If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$,</p> <p>then $A^{-1} = \frac{1}{ad - bc} \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$,</p> <p>where $ad - bc \neq 0$.</p>	<p>$A^{-1} = \frac{1}{ A } [c_{ij}]^T$</p> <p>$A^{-1} = \frac{1}{ A } \begin{bmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{bmatrix}$</p> <p>$A^{-1} = \frac{1}{ A } \text{adj } A$</p> <p>where $[c_{ij}]^T$ is called the adjoint of A (adj A).</p> <p>c_{ij} of the entry $a_{ij} = (-1)^{i+j} M_{ij}$</p>

<i>Cramer's Rule for 2×2 matrix</i>	<i>Cramer's Rule for 3×3 matrix</i>
<p>If $a_1x + b_1y = c_1$ $a_2x + b_2y = c_2$</p> <p>then $x = \frac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$ and $y = \frac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}},$</p> <p>where $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \neq 0$</p>	<p>$a_1x + b_1y + c_1z = d_1$ If $a_2x + b_2y + c_2z = d_2$ $a_3x + b_3y + c_3z = d_3$</p> <p>then $x = \frac{D_x}{D}, y = \frac{D_y}{D}, z = \frac{D_z}{D}$ where</p> <p>$D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, D_x = \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix},$</p> <p>$D_y = \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}, D_z = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$</p>

<i>Arithmetic sequence</i>	<i>Geometric sequence</i>
$a_n = a_1 + (n-1)d$	$a_n = a_1r^{n-1}, S_n = \frac{a_1(1-r^n)}{1-r}$
$S_n = \frac{n}{2}(a_1 + a_n)$	$S_\infty = \frac{a_1}{1-r}, r < 1$

Binomial Theorem

$$(a+b)^n = \sum_{k=0}^n \binom{n}{k} a^{n-k} b^k; \quad n \geq 1$$

The $(r+1)^{\text{st}}$ term in the expansion of $(a+b)^n$ is $\binom{n}{r} a^{n-r} b^r$.